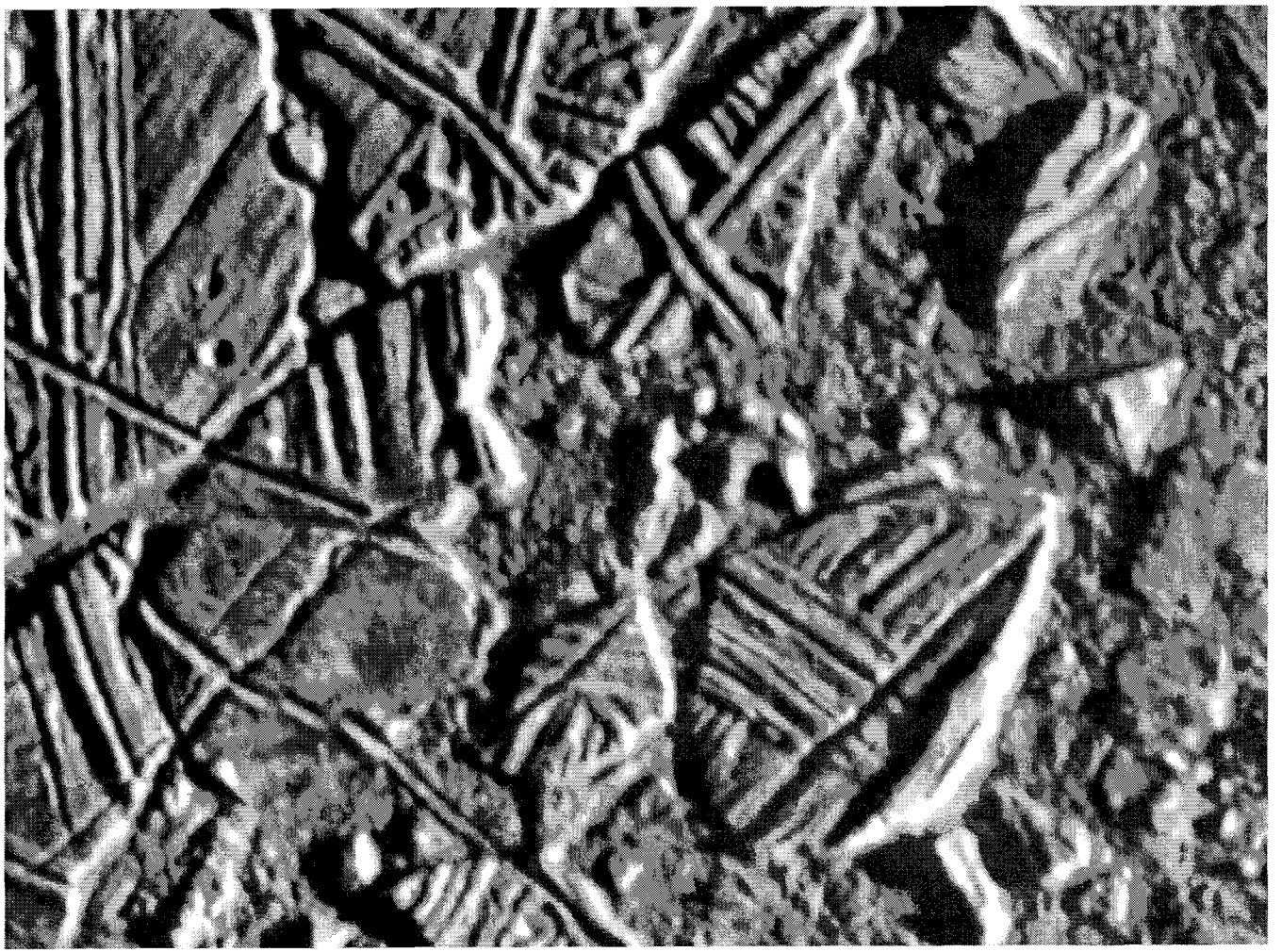
JPL

JPL SUBGLACIAL TECHNOLOGY DEVELOPMENTS IN ROBOTICS AND INSTRUMENTATION SUPPORTING A EUROPA OCEAN EXPLORATION MISSION

FRANK CARSEY
&
A. LONNE LANE
JPL

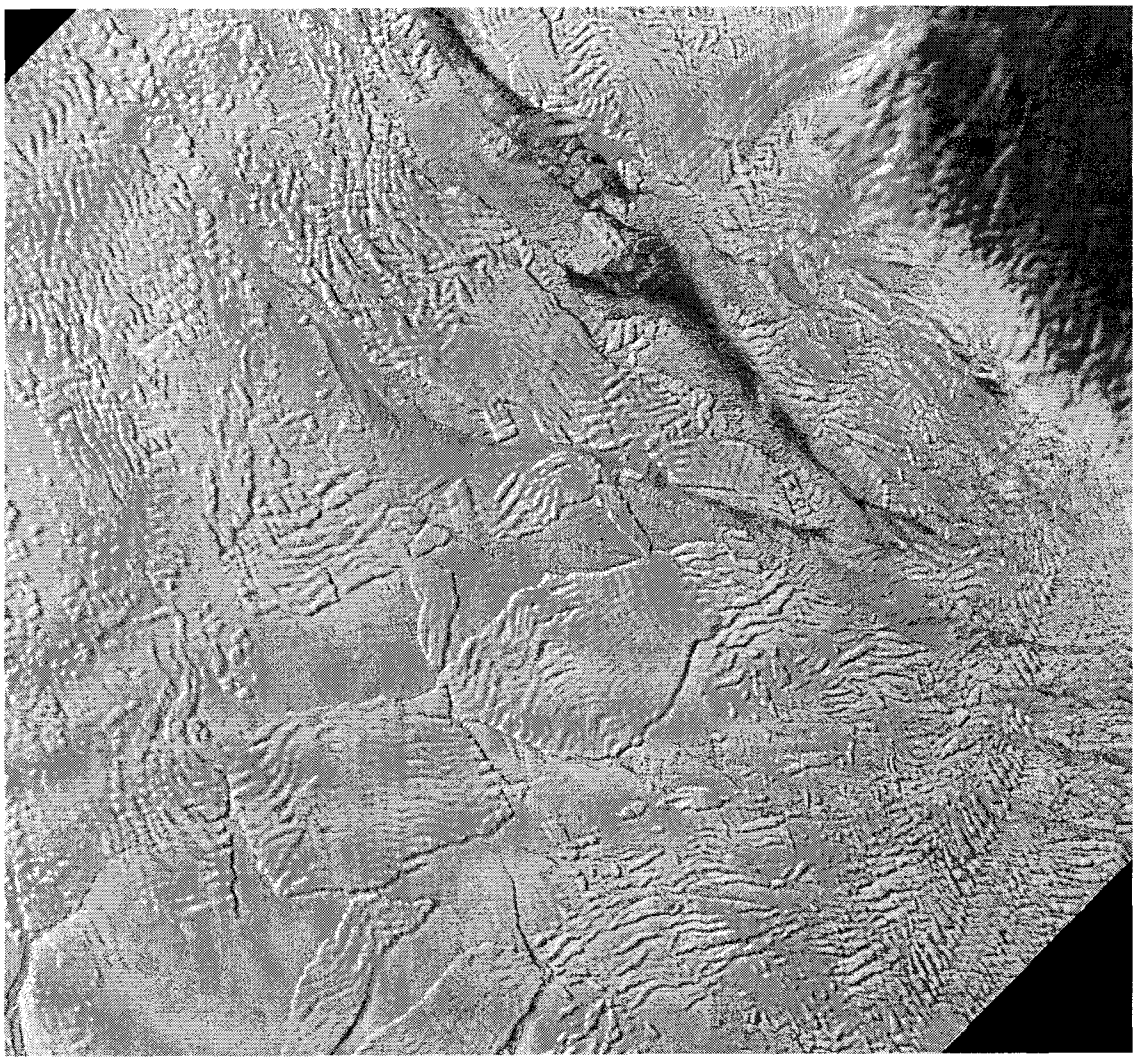
The Europa Chaos Region Provided Key Motivation for Earth Scientists to Look at Europa



Sea Ice Cakes

F Carsey, 2000

Antarctic Ice Shelf SAR Image



F Carsey, 2000

Thus: A Sea-Ice Person looks at a Europa Mission

From Galileo Data

- Astonishing Results
- Integrated Data Set Points to Ocean a Few Km's Beneath Surface
- Chemical Data of Surface Has 100 km Variability

Thus, No "Easy" Mission Answers Key Questions

- Surface Study Requires Long Traverse In Hostile Conditions
- Ocean Exploration Requires Deep Subsurface Mobility

Our Decision: Focus on the Ocean and Adjacent Ice

Crucial Technology Issues:

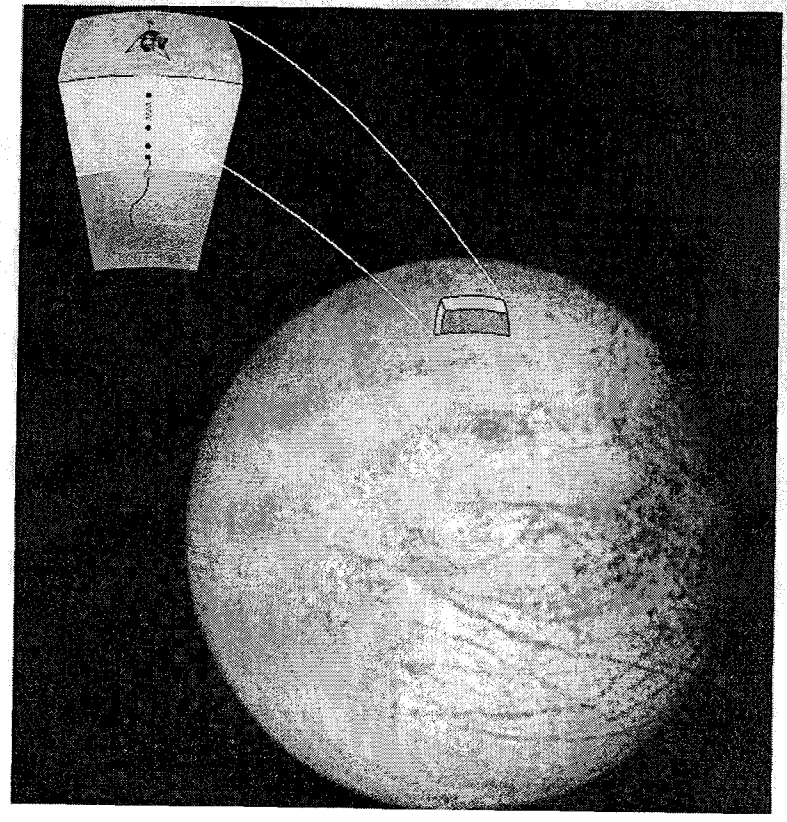
- Planetary Protection--Modest Progress
- Subsurface Mobility/Instrumentation--2 Projects
- Surface-Based Survey--One Concept in Development
- Communication--Scant Progress
- Scientific & Operational Autonomy--Scant Progress

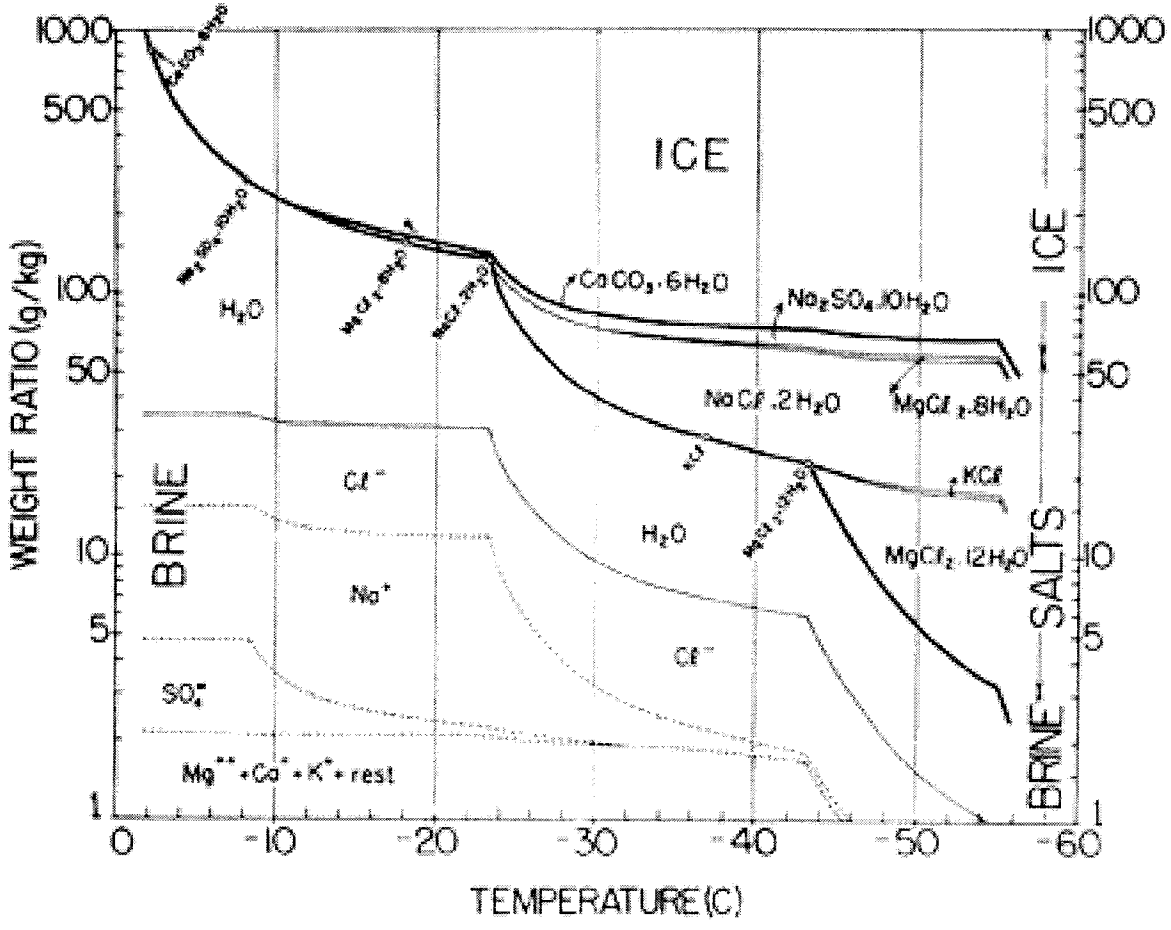
Marine Technology Society JOURNAL

VOLUME 33
NUMBER 4
WINTER 1999-2000

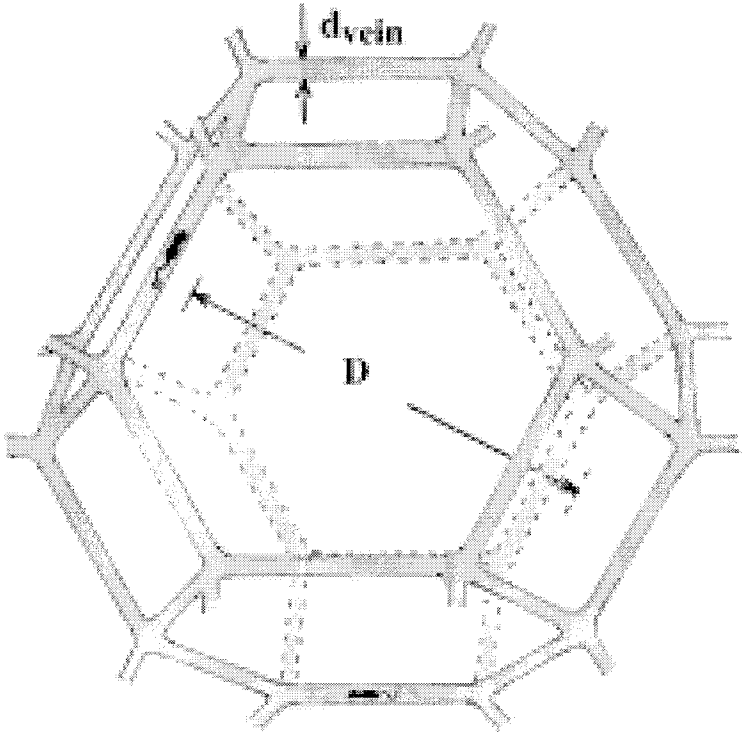
THE INTERNATIONAL, INTERDISCIPLINARY SOCIETY DEVOTED TO OCEAN AND MARINE ENGINEERING, SCIENCE, AND POLIC

Deep Ocean Frontiers





F Carsey, 2000



Ice Grains, 0.5 mm to 10 cm diameter, are bounded on triple junctions by brine/hydrated salt inclusions

ICE AS A THEME FOR SCIENCE AND TECHNOLOGY

Ice Has Properties That Make It Highly Interesting In Studies on Earth, Mars, Europa, Callisto, Titan...

In-Situ and Basal Processes Are Particularly Relevant--

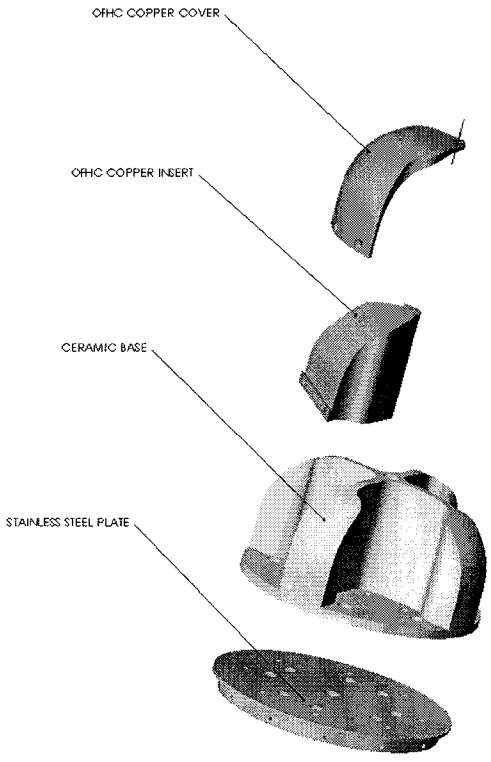
- Higher Temperatures Than Surface Ice
- Access to Minerals And/or LH2O
- Protection From Harmful Radiation, Chemistry

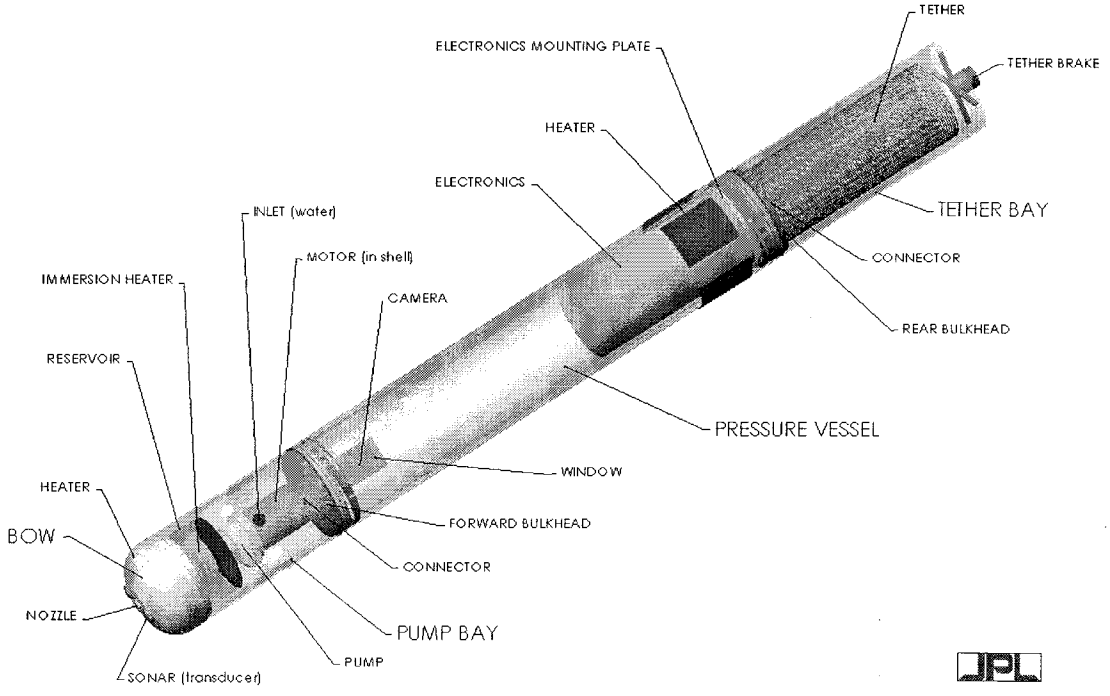
Exploration of Basal Regime Requires Technology Development: Access, Pressure, Communications, etc

This Development Has Elements Common to Other Science and Engineering

Planetary Preparation Can Be Partnered With Useful Science and Development

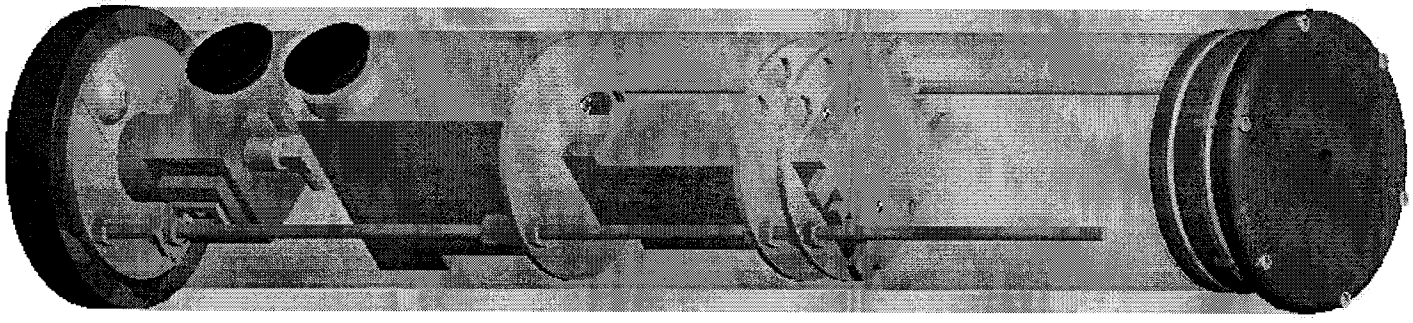
Baseline Design





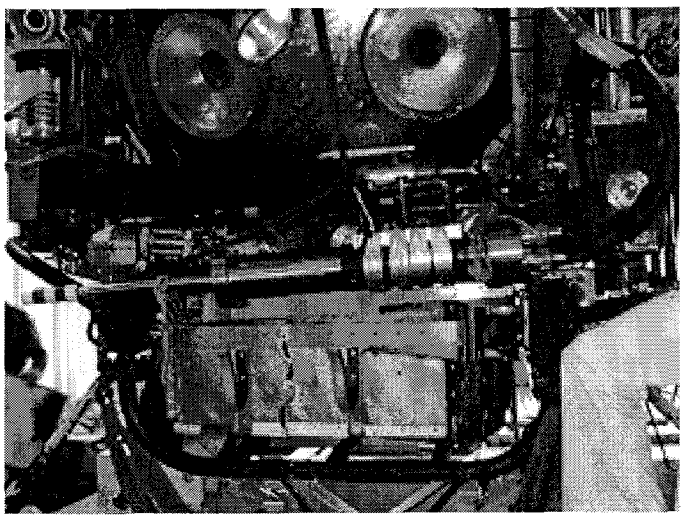
F Carsey, 2000

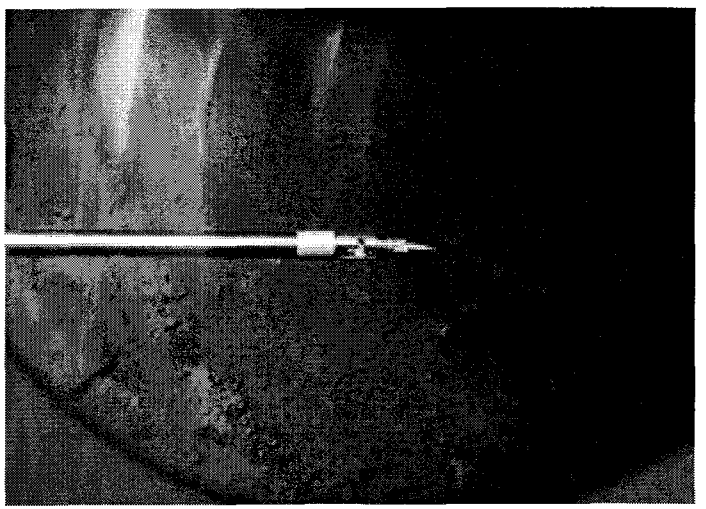
Ice Camera Probe
Caltech-JPL West Antarctic Basal Ice Study

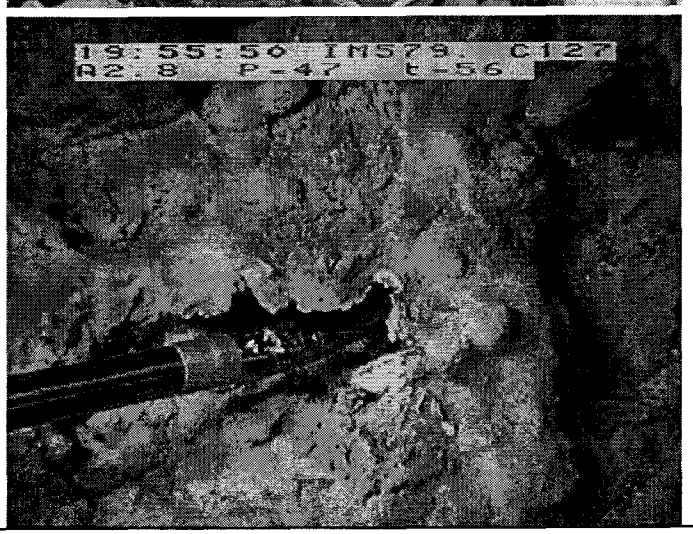


F Carsey, 2000

Hydrothermal Vent (Deep Water) Probe







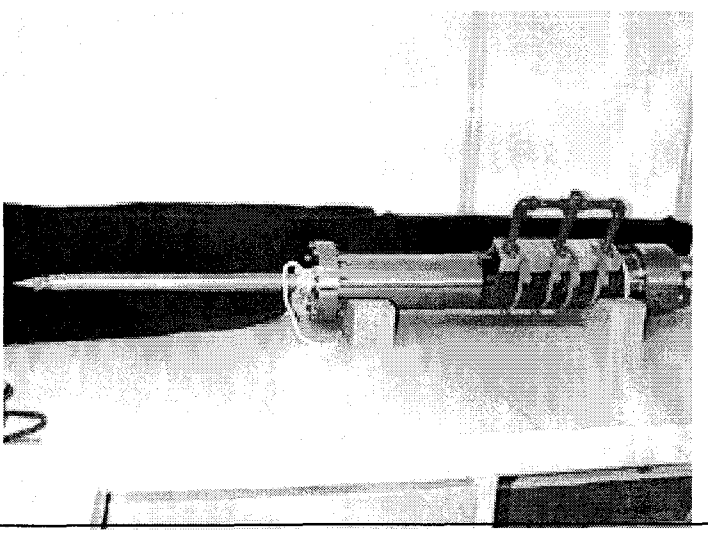
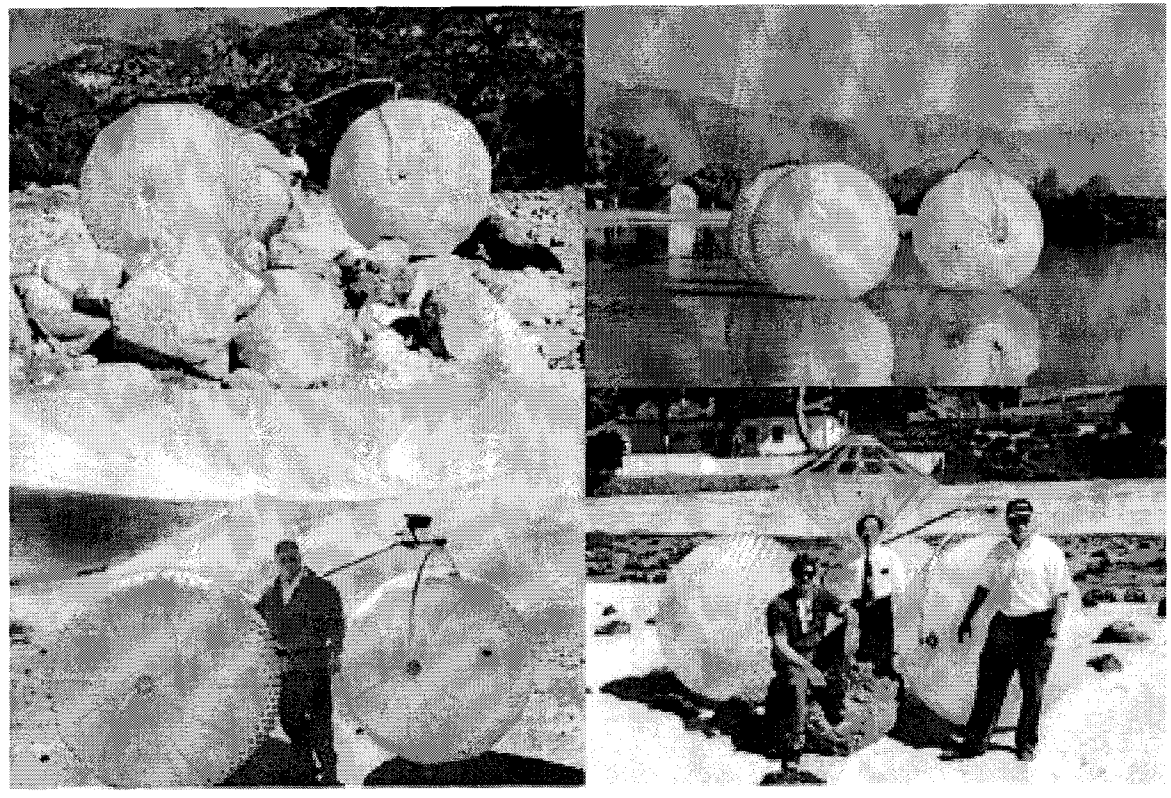
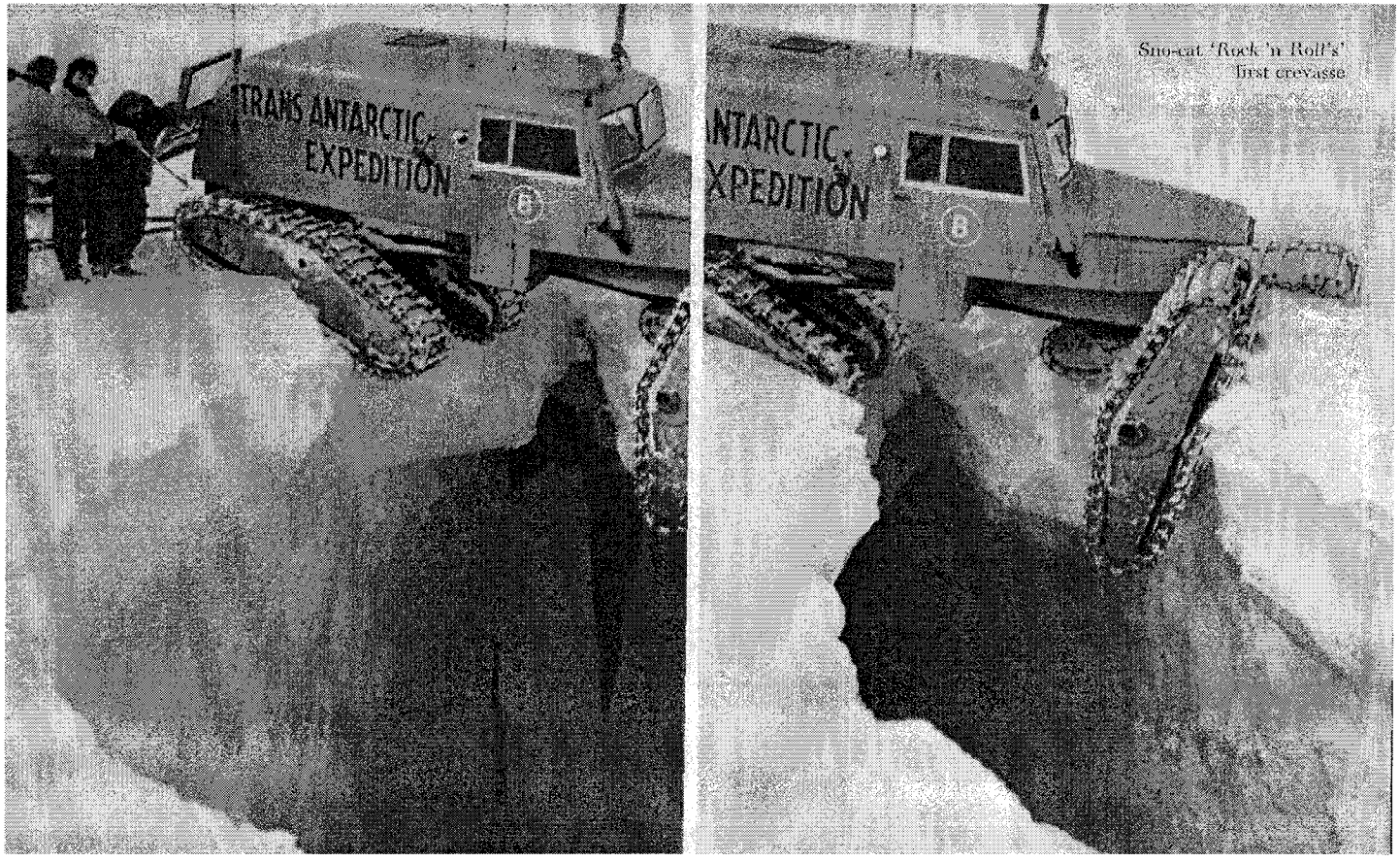


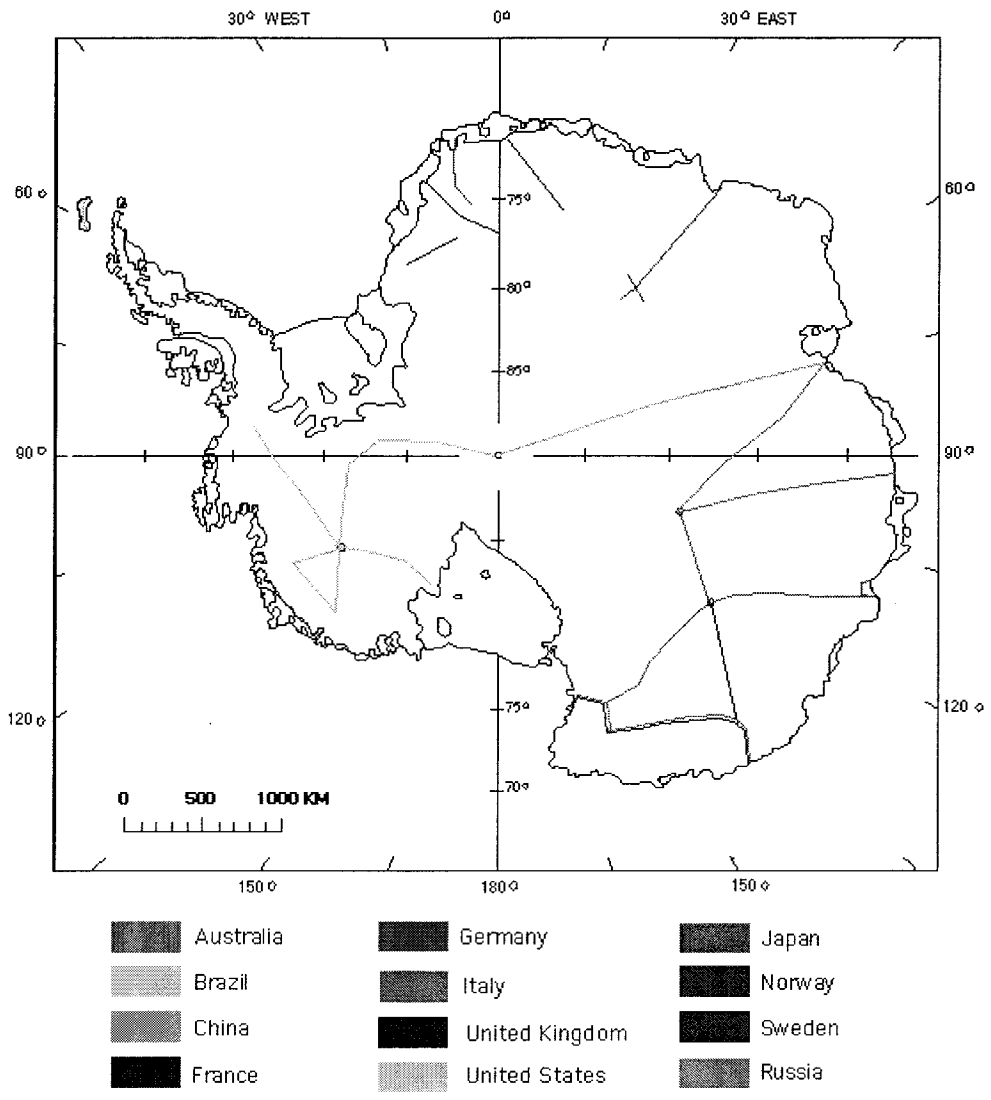
Figure 1 Inflatable Rover Engineering Model
Rover wheels are 1.5 m diameter. The proposed vehicle would probably have smaller wheels for stability in winds. JPL staff shown for scale; all scenes are in California where the trafficability of the rover was examined.



THE INFLATABLE ROVER DRIVES ON ALL TERRAINS



Snowcat breaking show bridge, TAE (Fuchs and Hillary, 1958).



ITASE

International Trans Antarctic Scientific Expedition (ITASE) planned traverses, starting in 1999-2000 field season

F Carsey, 2000